

The Export of Soybean in The United States

Introduction

Soybean or Soya bean is an edible grain native to East-Asia. The grain has many byproducts, and many culinary uses by itself. The United States is the largest producer of Soybean. The United States Department of Agriculture always has extensive reports on Soybean production, along with Soybean oil. Agricultural exports account for about \$133 billion of the total exports of USA. It is accounted for by government farm subsidies. This lowers their price internationally creating competition. Soybean exports are enhanced through bio-engineering and chemical additives which lower the cost of production. Soybeans account for about \$18 billion, which are mainly used for cattle feed and are genetically engineered.

The recent trade war between The United States and China makes us wonder as to what all factors affect the export of a commodity like Soybean. China is the biggest importer of US soybean, followed by the European Union. Apart from that, Brazil is the second largest exporter of Soybean. There are many factors which can affect the export of an agricultural product. One aspect of it is domestic yield conditions: weather, political scenario, subsidies, and more. Another aspect of it is the International demand: value of the dollar, currency exchange rate, etc. The last aspect of it being analyzed here the competitiveness of the price amongst other countries and other products.

I am studying these three major umbrella factors, with a multiple variable regression study. I have taken 20 data points, from 1999 to 2018. My dependent variable here was the bushels of soybean exported in the past 20 years. I collected data on the currency exchange rate of China, currency exchange rate of European Union, US dollar index, international price of wheat, soybean subsidies, corn prices internationally, prices of soybean, price of soybean in brazil, and inflation rate. I also created two dummy variables: one for whether there were any droughts in the soybean producing states that year, and another for whether the political party in the White House was democratic that year.

I provide evidence that my regression model fits the required assumptions for multiple regression. I noticed serious multicollinearity after regression, so I have one reduced model as well. There were no serious outliers either.

The results show that the Chinese Exchange Rate and the International price of Wheat are significant factors in determining the exported soybean in a particular year.

Data

Most of my data comes from the Federal Department of Agriculture. I had multiple regression models and I found that:

Insignificant Independent Variables: Soybean subsidies, corn prices internationally, prices of soybean, price of soybean in brazil, and inflation rate. Dummy variables: droughts, democratic party.

Significant Independent Variables: currency exchange rate of China, currency exchange rate of European Union, US dollar index, and international price of wheat.

Seriously correlated Independent variables: Currency exchange rate of European Union and the US dollar index.

So in my reduced model I have only two independent variables, one which is the Currency Exchange Rate of China and the International price of wheat, both of which negatively affect the model.

Regression Analysis

The initial model is as following:

Exported Bushels of Soybean in Millions = $\beta_0 + \beta_1(\text{US dollar index}) + \beta_2 (\text{US-China Currency Exchange Rate}) + \beta_3 (\text{Price of Wheat internationally}) + \beta_4 (\text{EU-US Currency Exchange rate}) + \epsilon$

All the other variables discussed were not significant at the $\alpha = 5\%$ level, but these four are. The R squared explains 86 percent of all the variations. In addition, the independent variables model is significant as a whole because the null hypothesis for the F-test for the validity of the overall model is rejected.

Serious Multicollinearity is found between the US dollar index and the EU-US Currency Exchange rate. Removing only one of the both results in the other becoming insignificant, so both of these variables are removed from the study.

In the reduced model, the adjusted R squared reduced slightly, showing that a certain amount of variance was explained by the variables. The partial F statistic is 2.3241 and the p value is 0.1320 so the null hypothesis cannot be rejected (i.e., being irrelevant).

So, the resulting equation will be:

Exported Bushels of Soybean in Millions = $\beta_0 + \beta_1 (\text{US-China Currency Exchange Rate}) + \beta_2 (\text{Price of Wheat internationally}) + \epsilon$

Empirical Results

The Reduced model suggests that when the price of wheat internationally increases by \$0.01, the total exports of soybean decrease by one billion four hundred seventy-three million three hundred thirty thousand bushels.

The Reduced model also suggests that a \$0.01 decrease in the Dollar to Yuan exchange rate leads to a five billion nine hundred eighty-five million eight hundred thirty thousand bushels decrease in the export of soybean.

These drastic numbers show just how sensitive the international market can be.

Summary and Discussion

The interesting ways of looking at these results is analyzing why these independent variables are important.

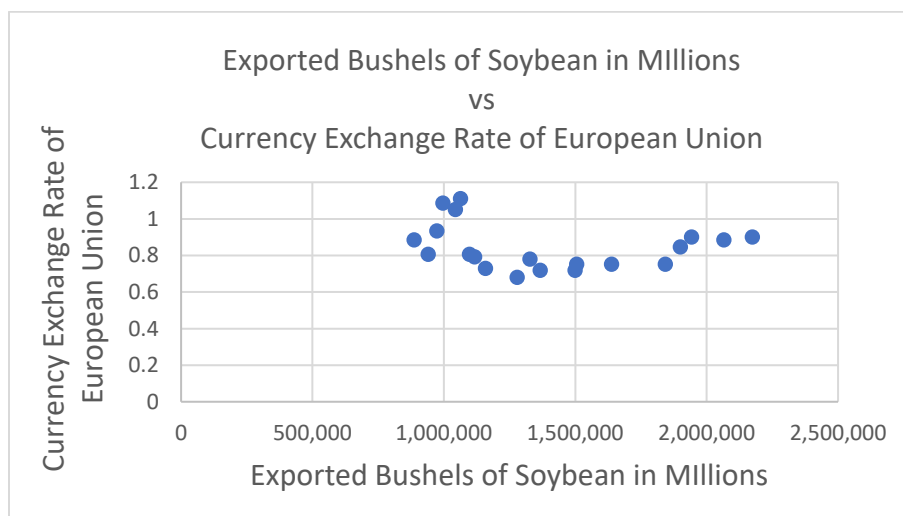
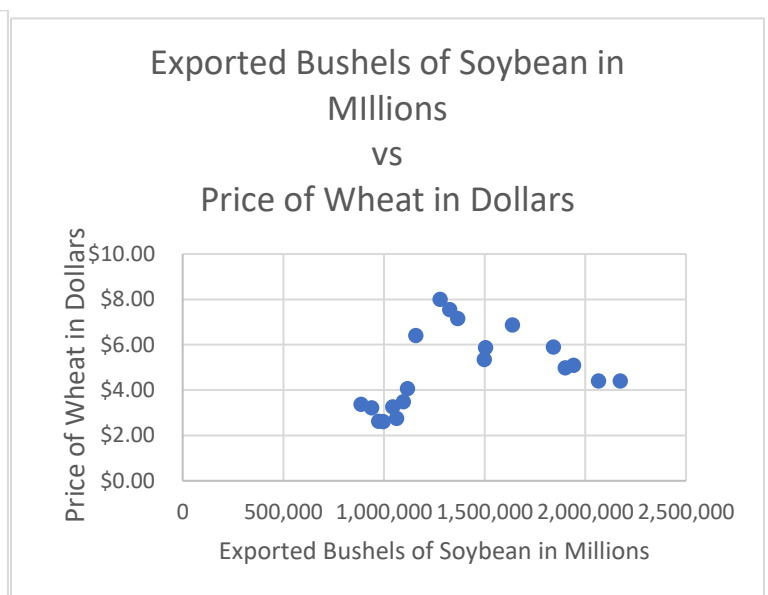
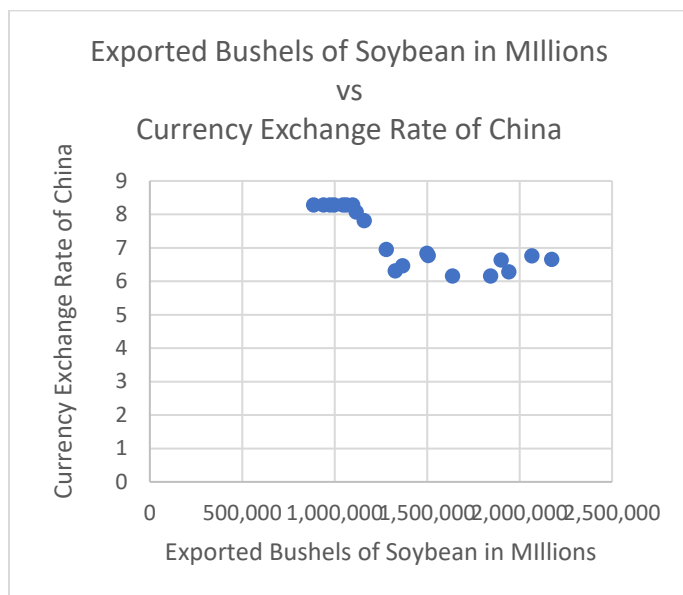
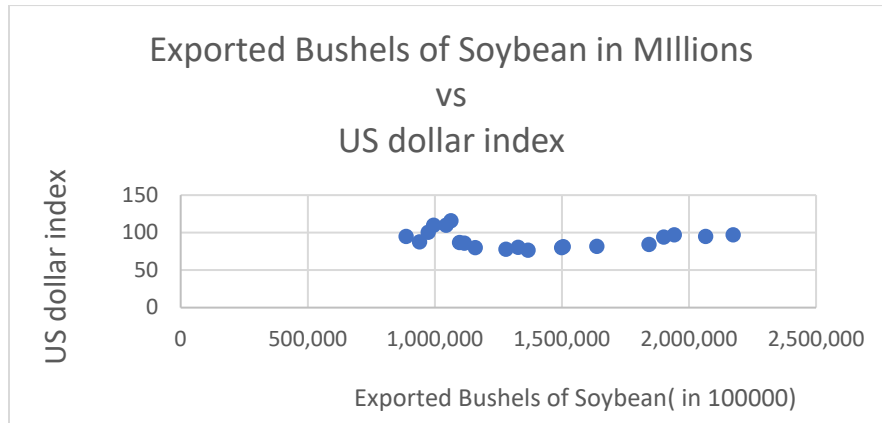
China-US Currency Exchange Rate: The dollar strength is measured through this variable. The value of the dollar to the largest importer of one of the largest exports of US shows how vulnerable the States are during the trade war. Last year, the exports to china fell by 98%, close to no soybean in November. China switched to Brazil, but the trade war is harmful to both countries in an unimaginable extent, together holding more than 25 percent of all world trade.

Price of Wheat: Here we can bring back concepts of microeconomics, specifically, Substitute Goods: When the price of one good inversely affects the demand for another good, they are substitute goods. Most importers of soybean use it either as consumer good for grains or as cattle feed, both of which uses are also sufficed by wheat. So even the slightest change in the price of wheat, affects the demand of soybean.

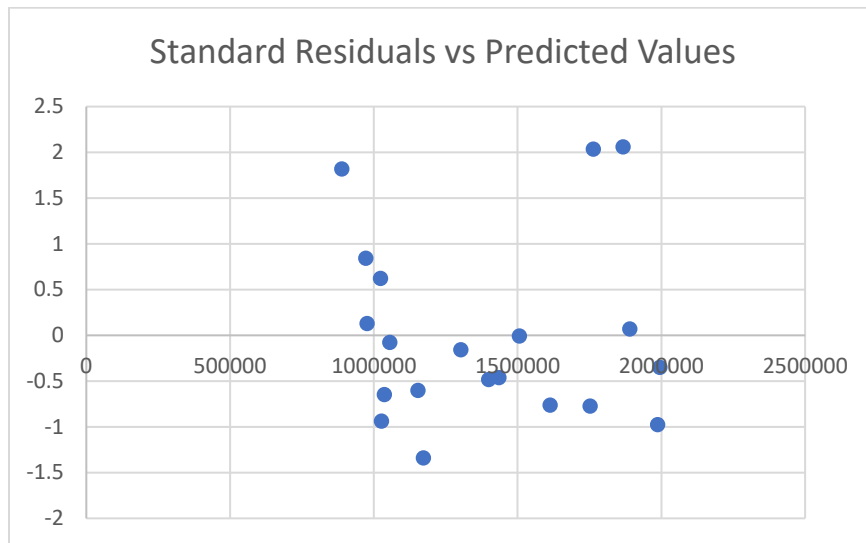
One downside of this study is that I only have 20 datapoints, so factors like droughts, subsidies for soybean, and inflation rate may actually be significant but this study is hindered to let us know.

Figures and Tables

Scatterplots of the dependent variable against the independent variables



Residuals vs Predicted



Descriptive Statistics

Soybean Exported in Millions		US dollar index (average)		Currency Exchange Rate China		Prices of Wheat		Currency Exchange Rate the Euro	
Mean	1390770.7	Mean	90.85425	Mean	7.289	Mean	4.861975	Mean	0.844847
Standard Error	91317.495	Standard Error	2.5959283	Standard Error	0.196896	Standard Error	0.384136	Standard Error	0.027982
Median	1303410	Median	87.2385	Median	6.89	Median	4.68855	Median	0.806452
Mode	#N/A	Mode	#N/A	Mode	8.28	Mode	#N/A	Mode	0.75188
Standard Deviation	408384.2527	Standard Deviation	11.609344	Standard Deviation	0.880543	Standard Deviation	1.71791	Standard Deviation	0.125141
Sample Variance	1.66778E+11	Sample Variance	134.77688	Sample Variance	0.775357	Sample Variance	2.951213	Sample Variance	0.01566
Kurtosis	-0.96477012	Kurtosis	-0.332596	Kurtosis	-1.91048	Kurtosis	-1.10894	Kurtosis	0.016357
Skewness	0.606485612	Skewness	0.7657968	Skewness	0.083026	Skewness	0.323424	Skewness	0.907374
Range	1287102	Range	39.58	Range	2.13	Range	5.3855	Range	0.430839
Minimum	886551	Minimum	76.454	Minimum	6.15	Minimum	2.6053	Minimum	0.680272
Maximum	2173653	Maximum	116.034	Maximum	8.28	Maximum	7.9908	Maximum	1.111111
Sum	27815414	Sum	1817.085	Sum	145.78	Sum	97.2395	Sum	16.89694
Count	20	Count	20	Count	20	Count	20	Count	20

Correlations

	US Dollar Index	Currency Exchange of China	Price of wheat	Currency Exchange Rate of EU
US Dollar Index	1			
Currency Exchange of China	0.508675078	1		
Price of wheat	-0.791847211	-0.76489295	1	
Currency Exchange Rate of EU	0.986975399	0.519065461	-0.774891043	1

Initial Regression Model

Regression Statistics								
Multiple R	0.931297							
R Square	0.867313							
Adjusted R Square	0.83193							
Standard Error	167422.5							
Observations	20							
ANOVA								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	4	2.74832E+12	6.8708E+11	24.51206	1.98E-06			
Residual	15	4.20455E+11	28030306143					
Total	19	3.16878E+12						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	5290957	1132787.811	4.670739406	0.000302	2876477	7705437	2876477	7705437
US Dollar Index	47406.94	22270.66588	2.128671957	0.050263	-61.8587	94875.74	-61.8587	94875.74
Currency Exchange China	-558958	71872.58079	-7.77707045	1.22E-06	-712151	-405765	-712151	-405765
Price of Wheat	-116435	51659.11332	-2.25390687	0.03959	-226544	-6326.04	-226544	-6326.04
Currency Exchange EU	-4222018	1966991.967	-2.14643361	0.048602	-8414562	-29473.5	-8414562	-29473.5

Reduced Model

Regression Statistics								
Multiple R	0.908953							
R Square	0.826195							
Adjusted R Square	0.805747							
Standard Error	179991.9							
Observations	20							
ANOVA								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	2	2.61803E+12	1.31E+12	40.40529	3.47E-07			
Residual	17	5.5075E+11	3.24E+10					
Total	19	3.16878E+12						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	6470176	680727.5377	9.504795	3.24E-08	5033966	7906385	5033966	7906385
US-China Exchange Rate	-598583	72800.3167	-8.22226	2.51E-07	-752179	-444988	-752179	-444988
Price of Wheat	-147333	37315.02947	-3.94837	0.001037	-226061	-68605.7	-226061	-68605.7

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